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(54) **SYSTEM AND METHOD FOR ANALYSIS AND PRESENTATION OF USED VEHICLE PRICING DATA**

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CPC ***G06Q 30/0278*** (2013.01); ***G06Q 10/06*** (2013.01); ***G06Q 30/02*** (2013.01); ***G06Q 30/0206*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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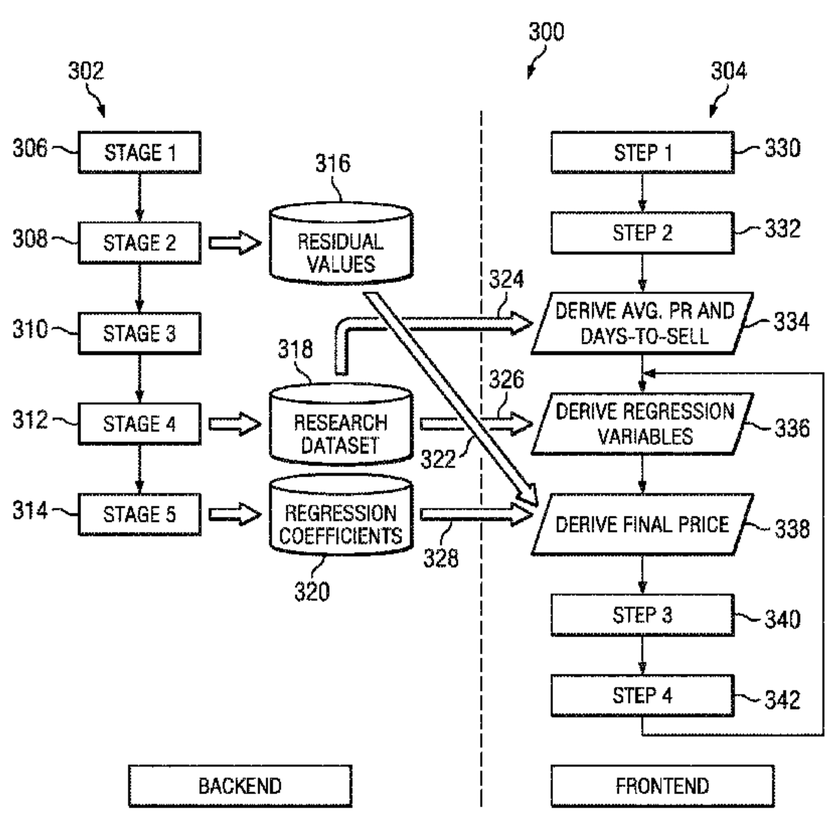
(57) **ABSTRACT**

To increase the efficiency of a used vehicle data processing process while still tailoring to an individual user's unique specifications on a used vehicle, at least some pre-calculations are performed by a backend process before a request for data for a specified vehicle is received through a web site or a web server on the Internet. A user can be presented with an interface where the user can make a variety of determinations. After the user requests data on a specific vehicle configuration, a frontend process handles user-provided data in conjunction with the data calculated in the backend process to ensure that the results are better tailored to the user's specific vehicle attributes. The results can include pricing data such as a trade-in price, a list price, an expected sale price or range of sale prices, market low sale price, market average sale price, market high sale price, etc.

20 Claims, 7 Drawing Sheets



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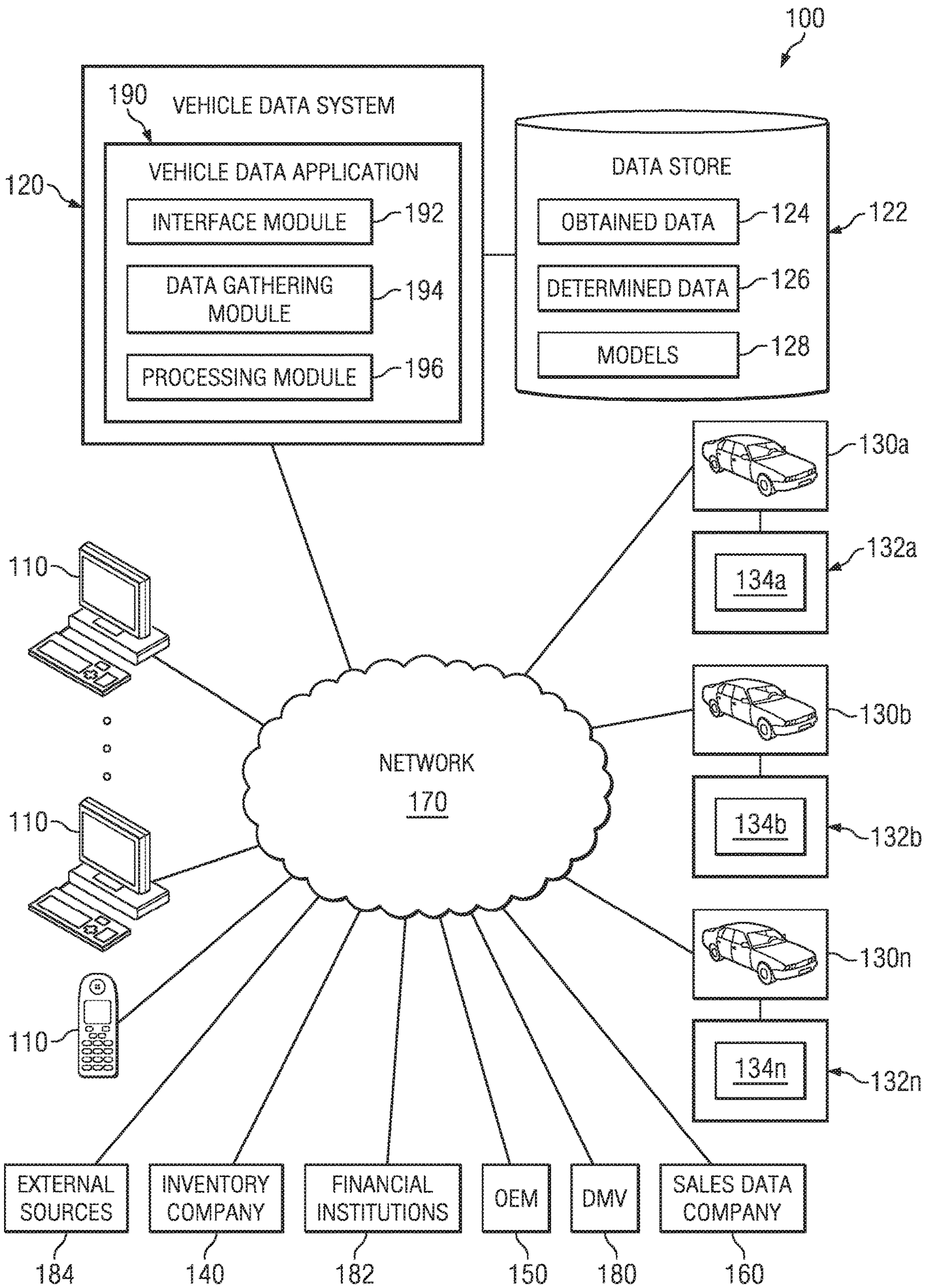
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VEHICLE DATA APPLICATION
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INTERFACE MODULE
192
DATA GATHERING MODULE
194
PROCESSING MODULE
196
DATA STORE
OBTAINED DATA
124
122
DETERMINED DATA
126
MODELS
128
130a
132a
134a
110
130b
NETWORK
170
134b
132b
110
130n
110
134n
132n
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INVENTORY COMPANY
FINANCIAL INSTITUTIONS
OEM
DMV
SALES DATA COMPANY
184
140
182
150
180
160

FIG. 1

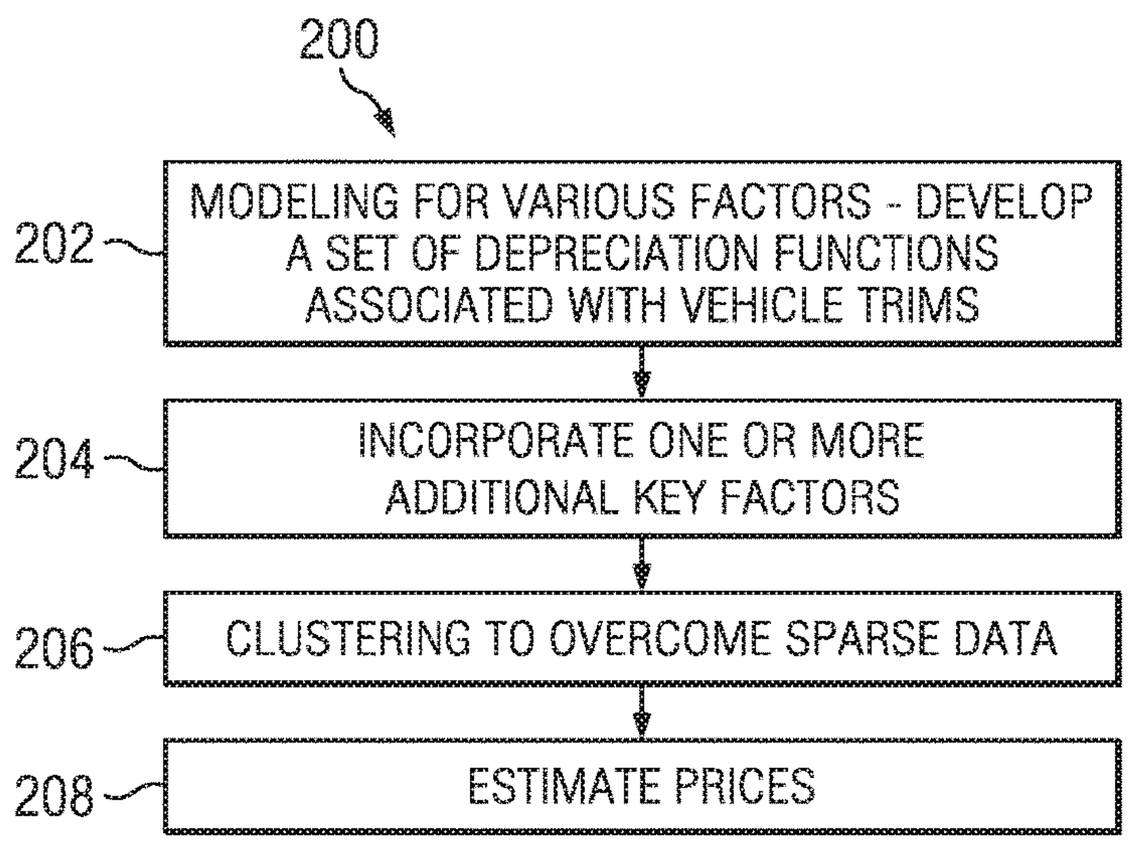
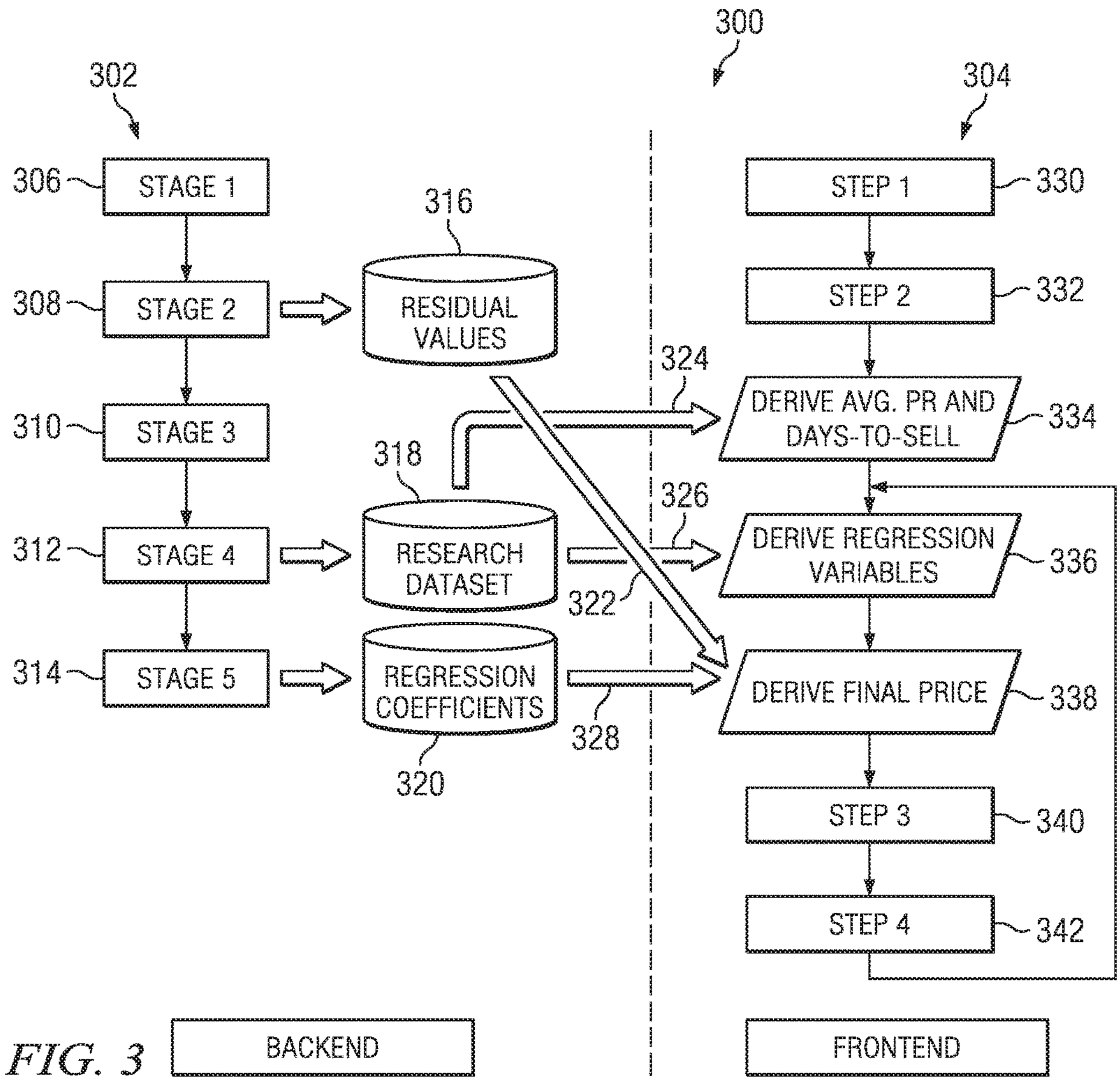

200
202
MODELING FOR VARIOUS FACTORS - DEVELOP A SET OF DEPRECIATION FUNCTIONS ASSOCIATED WITH VEHICLE TRIMS
204
INCORPORATE ONE OR MORE ADDITIONAL KEY FACTORS
206
CLUSTERING TO OVERCOME SPARSE DATA
208
ESTIMATE PRICES

FIG. 2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302
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STAGE 1
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STAGE 2
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STAGE 3
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STAGE 4
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STAGE 5
316
RESIDUAL VALUES
318
RESEARCH DATASET
320
REGRESSION COEFFICIENTS
322
324
326
328
STEP 1
330
STEP 2
332
DERIVE AVG. PR AND DAYS-TO-SELL
334
DERIVE REGRESSION VARIABLES
336
DERIVE FINAL PRICE
338
STEP 3
340
STEP 4
342
BACKEND
FRONTEND

FIG. 3

BIN	YEAR	MAKE	MODEL	ZIP CODE
1	2009	HONDA	CIVIC	90401
2	2005	TOYOTA	CAMRY	78701
...	...	...	...	...

FIG. 4

500

YEAR	MAKE	MODEL	TRIM	ZIP CODE	PR
2009	HONDA	CIVIC	DX	90401	0.96
2009	HONDA	CIVIC	LX	90401	0.958
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2009	HONDA	CIVIC	EX	90403	0.974
...	...	...	...	...	...

FIG. 5

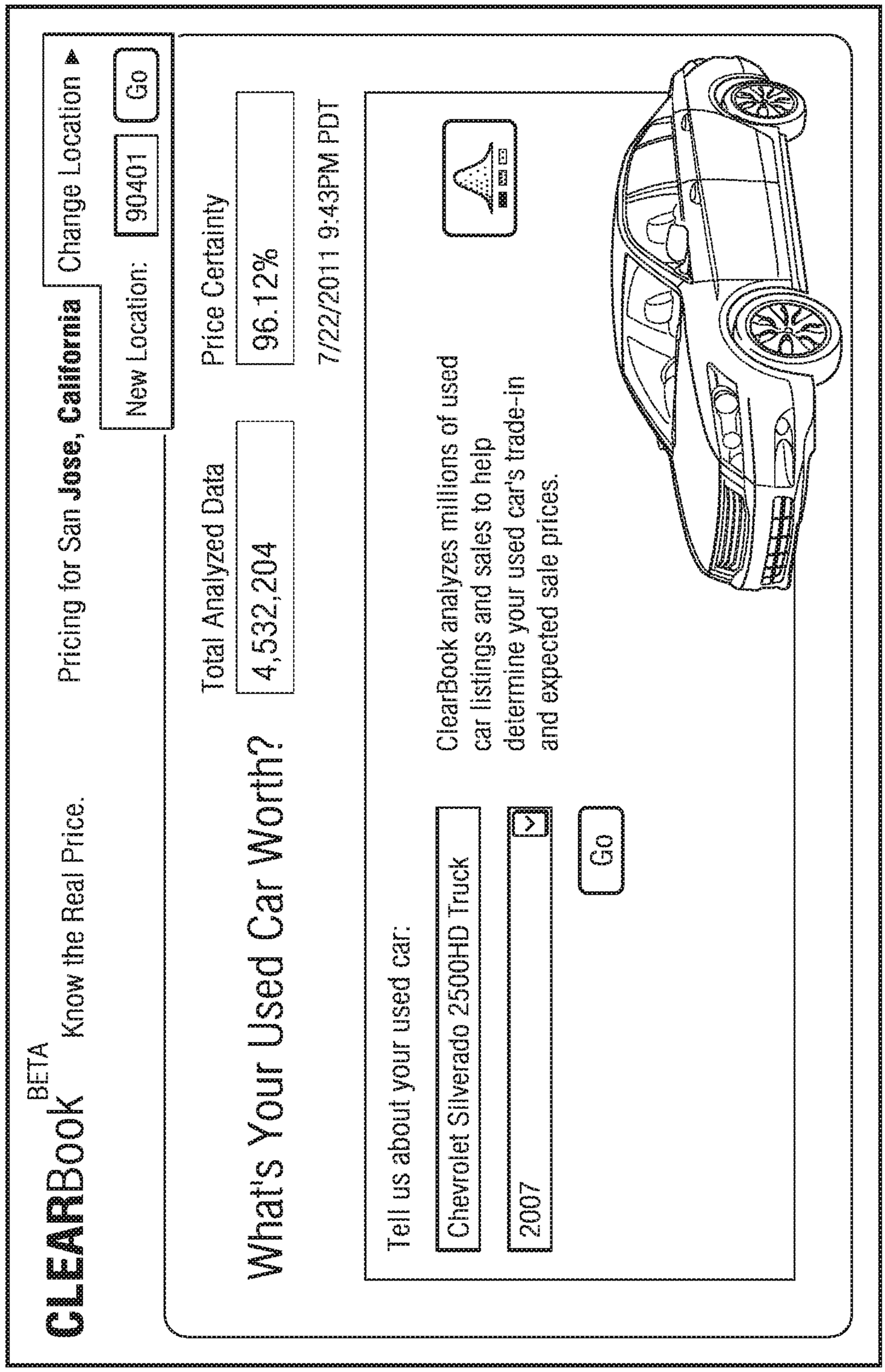

CLEARBook BETA
Know the Real Price.
Pricing for San Jose, California
Change Location
New Location:
90401
Go
What's Your Used Car Worth?
Total Analyzed Data
4,532,204
Price Certainty
96.12%
7/22/2011 9:43PM PDT
Tell us about your used car:
Chevrolet Silverado 2500HD Truck
2007
Go
ClearBook analyzes millions of used car listings and sales to help determine your used car's trade-in and expected sale prices.

FIG. 6

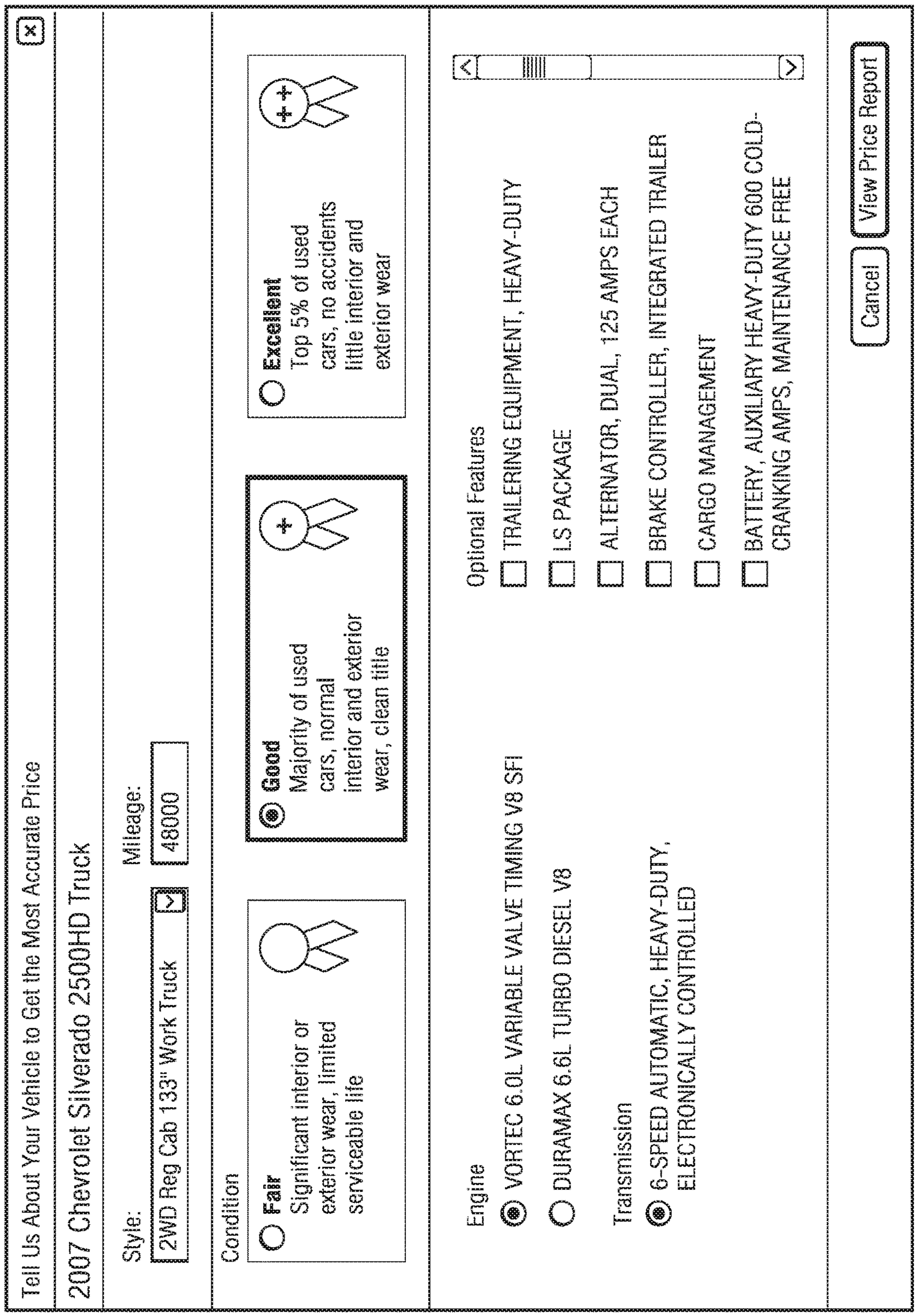
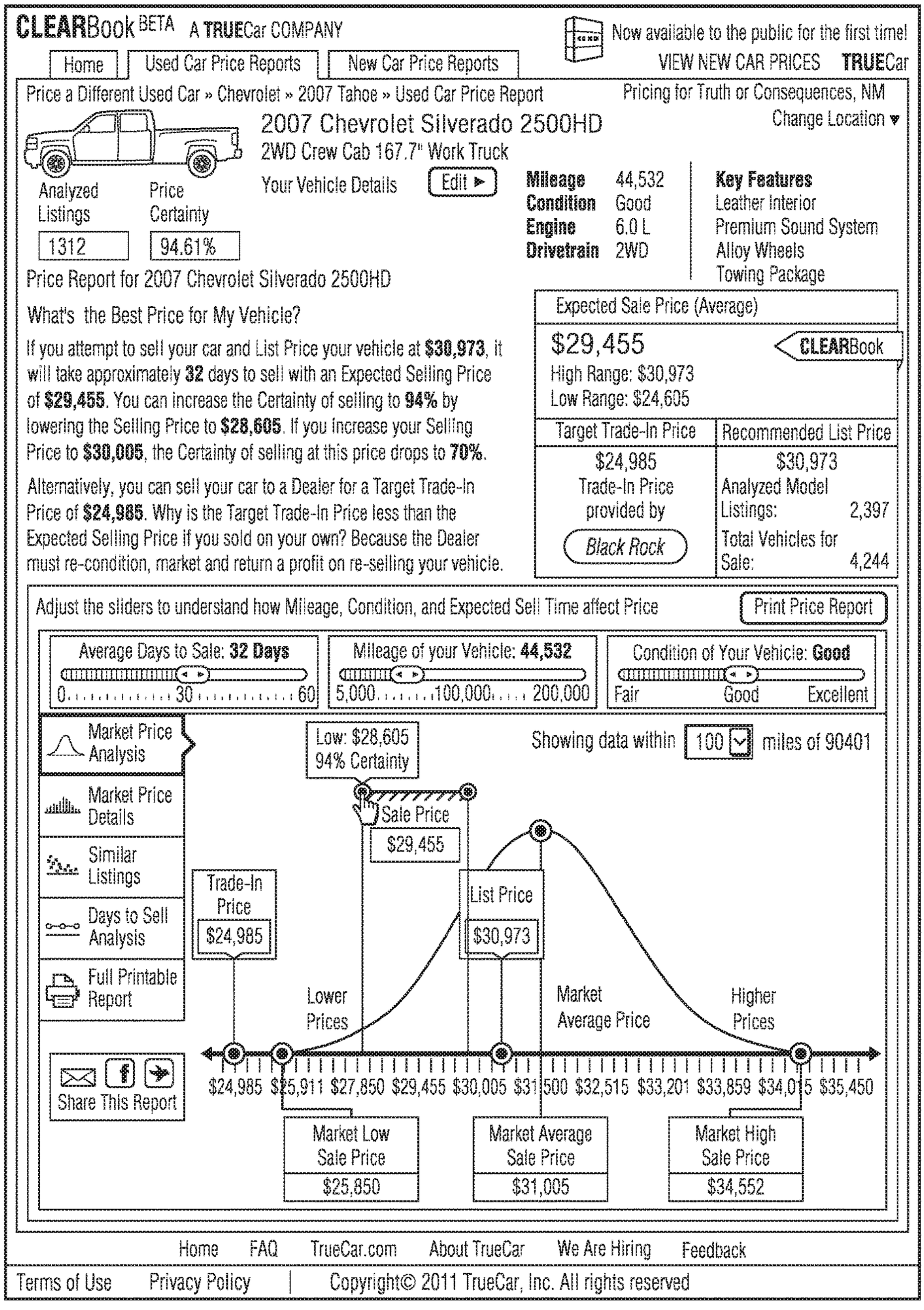

Tell Us About Your Vehicle to Get the Most Accurate Price
2007 Chevrolet Silverado 2500HD Truck
Style:
2WD Reg Cab 133" Work Truck
Mileage:
48000
Condition
Fair
Significant interior or exterior wear, limited serviceable life
Good
Majority of used cars, normal interior and exterior wear, clean title
Excellent
Top 5% of used cars, no accidents little interior and exterior wear
Engine
VORTEC 6.0L VARIABLE VALVE TIMING V8 SFI
DURAMAX 6.6L TURBO DIESEL V8
Transmission
6-SPEED AUTOMATIC, HEAVY-DUTY, ELECTRONICALLY CONTROLLED
Optional Features
TRAILERING EQUIPMENT, HEAVY-DUTY
LS PACKAGE
ALTERNATOR, DUAL, 125 AMPS EACH
BRAKE CONTROLLER, INTEGRATED TRAILER
CARGO MANAGEMENT
BATTERY, AUXILIARY HEAVY-DUTY 600 COLD-CRANKING AMPS, MAINTENANCE FREE
Cancel
View Price Report

FIG. 7

FIG. 8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Now available to the public for the first time!
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Home
Used Car Price Reports
New Car Price Reports
Price a Different Used Car » Chevrolet » 2007 Tahoe » Used Car Price Report
Pricing for Truth or Consequences, NM
Change Location
2007 Chevrolet Silverado 2500HD
2WD Crew Cab 167.7" Work Truck
Your Vehicle Details
Edit
Analyzed Listings
1312
Price Certainty
94.61%
Mileage 44,532
Condition Good
Engine 6.0 L
Drivetrain 2WD
Key Features
Leather Interior
Premium Sound System
Alloy Wheels
Towing Package
Price Report for 2007 Chevrolet Silverado 2500HD
What's the Best Price for My Vehicle?
If you attempt to sell your car and List Price your vehicle at $30,973, it will take approximately 32 days to sell with an Expected Selling Price of $29,455. You can increase the Certainty of selling to 94% by lowering the Selling Price to $28,605. If you increase your Selling Price to $30,005, the Certainty of selling at this price drops to 70%.
Alternatively, you can sell your car to a Dealer for a Target Trade-In Price of $24,985. Why is the Target Trade-In Price less than the Expected Selling Price if you sold on your own? Because the Dealer must re-condition, market and return a profit on re-selling your vehicle.
Expected Sale Price (Average)
$29,455
CLEARBook
High Range: $30,973
Low Range: $24,605
Target Trade-In Price
$24,985
Trade-In Price provided by
Black Rock
Recommended List Price
$30,973
Analyzed Model Listings: 2,397
Total Vehicles for Sale: 4,244
Adjust the sliders to understand how Mileage, Condition, and Expected Sell Time affect Price
Print Price Report
Average Days to Sale: 32 Days
0 30 60
Mileage of your Vehicle: 44,532
5,000 100,000 200,000
Condition of Your Vehicle: Good
Fair Good Excellent
Market Price Analysis
Market Price Details
Similar Listings
Days to Sell Analysis
Full Printable Report
Share This Report
Low: $28,605
94% Certainty
Sale Price
$29,455
Showing data within 100 miles of 90401
Trade-In Price
$24,985
List Price
$30,973
Lower Prices
Market Average Price
Higher Prices
$24,985 $25,911 $27,850 $29,455 $30,005 $31,500 $32,515 $33,201 $33,859 $34,015 $35,450
Market Low Sale Price
$25,850
Market Average Sale Price
$31,005
Market High Sale Price
$34,552
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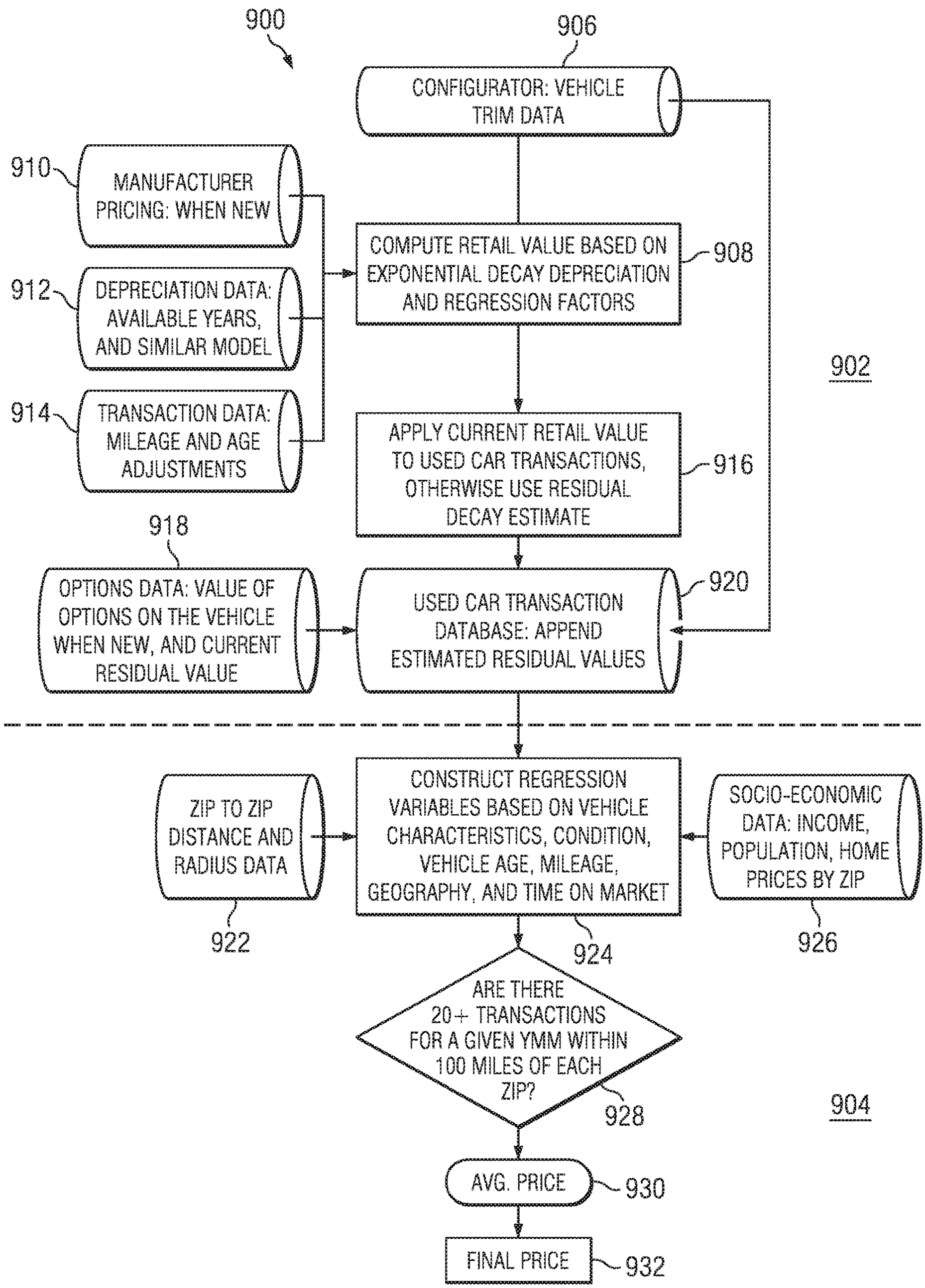
900
906
CONFIGURATOR: VEHICLE TRIM DATA
910
MANUFACTURER PRICING: WHEN NEW
912
DEPRECIATION DATA: AVAILABLE YEARS, AND SIMILAR MODEL
914
TRANSACTION DATA: MILEAGE AND AGE ADJUSTMENTS
COMPUTE RETAIL VALUE BASED ON EXPONENTIAL DECAY DEPRECIATION AND REGRESSION FACTORS
908
902
APPLY CURRENT RETAIL VALUE TO USED CAR TRANSACTIONS, OTHERWISE USE RESIDUAL DECAY ESTIMATE
916
918
OPTIONS DATA: VALUE OF OPTIONS ON THE VEHICLE WHEN NEW, AND CURRENT RESIDUAL VALUE
USED CAR TRANSACTION DATABASE: APPEND ESTIMATED RESIDUAL VALUES
920
ZIP TO ZIP DISTANCE AND RADIUS DATA
CONSTRUCT REGRESSION VARIABLES BASED ON VEHICLE CHARACTERISTICS, CONDITION, VEHICLE AGE, MILEAGE, GEOGRAPHY, AND TIME ON MARKET
SOCIO-ECONOMIC DATA: INCOME, POPULATION, HOME PRICES BY ZIP
922
924
926
ARE THERE 20+ TRANSACTIONS FOR A GIVEN YMM WITHIN 100 MILES OF EACH ZIP?
928
904
AVG. PRICE
930
FINAL PRICE
932

FIG. 9

SYSTEM AND METHOD FOR ANALYSIS AND PRESENTATION OF USED VEHICLE PRICING DATA

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of, and claims a benefit of priority under 35 U.S.C. § 120 from U.S. patent application Ser. No. 16/148,695, filed Oct. 1, 2018, issued as U.S. Pat. No. 10,733,639, entitled "SYSTEM AND METHOD FOR ANALYSIS AND PRESENTATION OF USED VEHICLE PRICING DATA," which is a continuation of and claims a benefit of priority under 35 U.S.C. 120 from U.S. patent application Ser. No. 14/145,252, filed Dec. 31, 2013, issued as U.S. Pat. No. 10,108,989, entitled "SYSTEM AND METHOD FOR ANALYSIS AND PRESENTATION OF USED VEHICLE PRICING DATA," which is a continuation of and claims a benefit of priority under 35 U.S.C. 120 from U.S. patent application Ser. No. 13/554,743, filed on Jul. 20, 2012, issued as U.S. Pat. No. 8,645,193, entitled "SYSTEM AND METHOD FOR ANALYSIS AND PRESENTATION OF USED VEHICLE PRICING DATA," which, in turn, claims a benefit of priority under 35 U.S.C. § 119(e) from U.S. Provisional Application No. 61/512,787, filed Jul. 28, 2011, entitled "SYSTEM AND METHOD FOR ANALYSIS AND PRESENTATION OF USED VEHICLE PRICING DATA." All applications referenced in this paragraph are fully incorporated by reference herein for all purposes.

COPYRIGHT NOTICE

TECHNICAL FIELD

The present disclosure relates to the aggregation, analysis, and presentation of transaction and pricing data related to vehicles, including used vehicles.

BACKGROUND OF THE RELATED ART

Sellers sometimes have a difficult time determining how they should price a used vehicle. This difficulty is exacerbated by the vagaries of used car transactions, especially in comparison with the sale or purchase of new cars.

For example, (a) condition is a critical factor to the value of a used car but it doesn't apply to new cars; (b) Mileage on a used car affects the value whereas it can be ignored on new cars; (c) In general, the older the vehicle, the less the price; age is not an issue with new cars; (d) Used car pricing has a much wider range of model years and many more vehicle models to work with; new cars only include at most vehicles in the most recent 2 or 3 model years; (e) Sales velocity drops dramatically for older vehicles, especially for those 10+ years old cars; thus, far fewer data points for analysis are available; In most cases, an adequate number of comparable new car transactions are available; (f) Options on a particular used car cannot be configured. For new cars, options can be customized with dealer-installed options or by direct order from manufacturers.

It is thus desirable to account for these various challenges and factors when providing a buyer or seller with pricing data associated with a specified used vehicle, including for example, historical transaction data, a trade-in price, a list price, an expected sale price or range of sale prices or an expected time to sale. It is also desired that certain of the pricing data be presented in conjunction with the transaction data associated with the specified used vehicle. It is further desired that this transaction data may be presented as a distribution of the transaction data and certain pricing data including such price points as market low sale price, market average sale price or market high sale price may be presented relative to the transaction data.

SUMMARY OF THE DISCLOSURE

These, and other, aspects of the invention will be better appreciated and understood when considered in conjunction with the following description and the accompanying drawings. The following description, while indicating various embodiments of the invention and numerous specific details thereof, is given by way of illustration and not of limitation. Many substitutions, modifications, additions or rearrangements may be made within the scope of the invention, and the invention includes all such substitutions, modifications, additions or rearrangements.

Embodiments of systems and methods for the aggregation, analysis, and display of data for used vehicles are disclosed. In particular, in certain embodiments, historical transaction data for used vehicles may be obtained and processed to determine pricing data, where this determined pricing data may be associated with a particular configuration of a vehicle. The user can then be presented with an interface pertinent to the vehicle configuration utilizing the aggregated data set or the associated determined data where the user can make a variety of determinations. This interface may, for example, be configured to present the historical transaction data visually, with the pricing data such as a trade-in price, a list price, an expected sale price or range of sale prices, market low sale price, market average sale price, market high sale price, etc. presented relative to the historical transaction data.

In one embodiment, modeling that accounts for various factors may be utilized to accurately estimate sale and listing prices for a given used car. Embodiments of such a modeling approach may include the development of a set of depreciation functions associated with vehicle trims to facilitate estimation of the base value of a used car. Key factors may be incorporated into regression models to estimate their individual impact or interactions. These factors may include, for example: Mileage; Condition; Geographic information (region, state, zip code, metro, DMA, etc.); Demographic information (household income, house value, etc.); Vehicle attributes (transmission, engine, drive train, hybrid, electric, etc.); Vehicle options; Days to sell; etc. The days-to-sell factor may be utilized to capture the market attribute that for a given used car the expected price varies depending on how soon the owner wants to sell their vehicle.

In certain embodiments, in addition to the above factors that are considered in regression models, clustering approaches may also be applied to overcome sparse data. The purpose of this clustering may be to identify similar vehicles and similar geographic regions so that data points can be pooled together for regression analysis. Thus, using

embodiments of this modeling or regression, pricing data, including estimated sales prices or listing prices may be determined.

Using such estimated sales prices or listing price (e.g., a price at which the car may be offered for sale) for a used vehicle, then, a seller can better make decisions regarding the sale of a used vehicle, as the market factors corresponding to the vehicle may be better understood. In fact, embodiments of such vehicle data systems can help everyone involved in the used car sales process including sellers (e.g., private sellers, wholesalers, dealers, etc.) and consumers, and even intermediaries by presenting both simplified and complex views of data. By utilizing visual interfaces in certain embodiments pricing data may be presented as a price curve, bar chart, histogram, etc. that reflects quantifiable prices or price ranges relative to reference pricing data points. Using these types of visual presentations may enable a user to better understand the pricing data related to a specific vehicle configuration. Such interfaces may be, for example, a website such that the user can go to the website to provide relevant information concerning a specific vehicle configuration and the interface corresponding to the specific vehicle configuration is presented to the user through the website.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings accompanying and forming part of this specification are included to depict certain aspects of the invention. A clearer impression of the invention, and of the components and operation of systems provided with the invention, will become more readily apparent by referring to the exemplary, and therefore nonlimiting, embodiments illustrated in the drawings, wherein identical reference numerals designate the same components. Note that the features illustrated in the drawings are not necessarily drawn to scale.

FIG. **1** depicts of one embodiment of a topology including a vehicle data system.

FIG. **2** depicts one embodiment of a method for determining and presenting pricing data.

FIG. **3** depicts an embodiment of a method for determining and presenting pricing data.

FIG. **4** depicts an exemplary bin for use in determining and presenting pricing data.

FIG. **5** depicts exemplary historical data for an average price determination.

FIG. **6** depicts one embodiment of an interface.

FIG. **7** depicts one embodiment of an interface.

FIG. **8** depicts one embodiment of an interface.

FIG. **9** depicts an embodiment of a method for determining and presenting pricing data.

DETAILED DESCRIPTION

The disclosure and various features and advantageous details thereof are explained more fully with reference to the exemplary, and therefore non-limiting, embodiments illustrated in the accompanying drawings and detailed in the following description. It should be understood, however, that the detailed description and the specific examples, while indicating the preferred embodiments, are given by way of illustration only and not by way of limitation. Descriptions of known programming techniques, computer software, hardware, operating platforms and protocols may be omitted so as not to unnecessarily obscure the disclosure in detail. Various substitutions, modifications, additions and/or rearrangements within the spirit and/or scope of the underlying inventive concept will become apparent to those skilled in the art from this disclosure.

Software implementing embodiments disclosed herein may be implemented in suitable computer-executable instructions that may reside on a computer-readable storage medium. Within this disclosure, the term "computer-readable storage medium" encompasses all types of data storage medium that can be read by a processor. Examples of computer-readable storage media can include, but are not limited to, volatile and non-volatile computer memories and storage devices such as random access memories, read-only memories, hard drives, data cartridges, direct access storage device arrays, magnetic tapes, floppy diskettes, flash memory drives, optical data storage devices, compact-disc read-only memories, and other appropriate computer memories and data storage devices.

Attention is now directed to the aggregation, analysis, display and of pricing data for vehicles, including used vehicles. In particular, actual sales transaction data may be obtained from a variety of sources. This historical transaction data may be aggregated into data sets and the data sets processed to determine desired pricing data, where this determined pricing data may be associated with a particular configuration (e.g., make, model, power train, options, mileage, etc.) of a vehicle. An interface may be presented to a user where a user may provide relevant information such as attributes of a vehicle configuration, a geographic area, etc. The user can then be presented with a display pertinent to the provided information utilizing the aggregated data set or associated determined pricing data where the user can make a variety of determinations such as a trade-in price, a list price, an expected sale price or range of sale prices or an expected time to sale.

In one embodiment, the expected sale price, or sale prices within a range of expected sale prices may have a percentage certainty associated with them which reflect the probability of the specified used vehicle selling at that price. The list price and the expected sale price may be linked to a number of average days to sale such that the list price, expected sale price and average days to sale may be interdependent. The interface may offer a user the ability to adjust one or more pieces of this pricing data (e.g., the average number of days to sale) and thereby adjust the interface to present the pricing data calculated in response to this adjustment. Furthermore, such pricing data may be presented in conjunction with transaction data associated with the specified used vehicle. This transaction data may be presented as a distribution of the transaction data and include pricing data including such price points such as market low sale price, market average sale price or market high sale price.

In certain embodiments, then, using data feeds from multiple sources, model variables may be constructed and multivariate regressions for generating pricing data for used car valuations may be built. In the used car space, there are multiple price points that are of interest, including specifically List Prices, Sale Prices, and Trade-In Prices.

Thus, embodiments of the systems and methods disclosed herein can provide accurate pricing guidance with respect to at least each of these price points, along with a range of sale prices that may be useful for both a buyer and/or a seller.

To provide such information embodiments may utilize the following approach: when a user enters his vehicle information into a user interface, variables about the specifics of that vehicle are obtained. For example, data on year, make, model, options, transmission, engine cylinders, color, condition, mileage, original MSRP and Invoice price are may be

obtained. From this data, a baseline valuation can be obtained. This valuation can be calculated in multiple ways depending on the embodiment, but, in one embodiment may effectively be a depreciation value for the class of vehicle associated with the vehicle selected by the user. Also, at this time, the vehicle's "bin" may be specified: the bin is defined as the group of vehicles in the historical transactions that are of the same make, model, body type, same year (or generation), similar time frame, or similar geography. Recent transactions (e.g., within a certain time window) within the same bin may be evaluated based on a model (which will be described in more detail later herein), to make further refinements to the price being anticipated for the vehicle. This process may be done for listing, sale, and trade-in prices.

In some embodiments, to increase the efficiency of the process while still tailoring the results to the individual user's unique specifications, at least some pre-calculation (e.g., calculation done before a specific request from a user for data for a specified vehicle) may be done. This pre-calculation may be done in what will herein be referred to as the "backend." The backend as used herein means that it may not be done in response to a user request, or may be done at any point before a particular user requests data on a specified vehicle. Thus, for example, if certain calculations are on certain time frame (e.g., every day, every week, every hour, etc.) these may be considered to be done on the backend. Additionally, for example, if calculations are done before a first user specifies a vehicle and requests pricing data on that vehicle pre-calculation may have been done on the backend with respect to that first user and his request. If certain calculations are done after the first user has received his information but before a second user requests data on a specified vehicle those calculation may be understood to have been done on the backend. When such pre-calculation occurs, after the user requests data on a specified vehicle configuration, there may be a process flow for handling this user provided incremental data (for example, in conjunction with the data calculated in the backend) to ensure the results are better tailored to the user's specific vehicle attributes.

Embodiments of the above systems and methods will now be described herein in more detail. As an overview, initially a general description on data and data sources utilized will be described. Then, the method utilized to construct a model based on a research data set is described. In certain embodiments, models may be constructed on one or more different levels, for example, a model may be built on a national level, a make level, a model level, a bin level, etc. Furthermore, there may be a set of models for each price which it is desired to determine. For example, there may be a set of models for list price, a set of model for sale price and a set of models for trade in price. Thus, for example, there may be a set of models for list price, each model corresponding to a bin; a set of models for sale price, each model corresponding to a bin and a set of models for trade in price, each model corresponding to a bin. Finally, the implementation and use of a model is described, including the use of such a model in the frontend (calculations done in response to a user's request for data for a specific vehicle configuration) phases of that implementation.

Embodiments of the systems and methods of the invention may be better explained with reference to FIG. **1** which depicts one embodiment of a topology which may be used to implement certain embodiments. Topology **100** comprises a set of entities including vehicle data system **120** (also referred to herein as the TrueCar system) which is coupled through network **170** to computing devices **110** (e.g., computer systems, personal data assistants, kiosks, dedicated terminals, mobile telephones, smart phones, etc.), and one or more computing devices at inventory companies **140**, original equipment manufacturers (OEM) **150**, sales data companies **160**, financial institutions **182**, external information sources **184**, departments of motor vehicles (DMV) **180**, and one or more associated point of sale locations, in this embodiment, car dealers **130**. Network **170** may be for example, a wireless or wireline communication network such as the Internet or wide area network (WAN), publicly switched telephone network (PTSN) or any other type of electronic or non-electronic communication link such as mail, courier services or the like.

Vehicle data system **120** may comprise one or more computer systems with central processing units executing instructions embodied on one or more computer readable media where the instructions are configured to perform at least some of the functionality associated with embodiments of the invention. These applications may include a vehicle data application **190** comprising one or more applications (instructions embodied on a computer readable media) configured to implement an interface module **192**, data gathering module **194**, and processing module **196** utilized by the vehicle data system **120**. Furthermore, vehicle data system **120** may include data store **122** operable to store obtained data **124**, data **126** determined during operation, models **128** which may comprise a set of dealer cost model or price ratio models, or any other type of data associated with embodiments of the invention or determined during the implementation of those embodiments.

Vehicle data system **120** may provide a wide degree of functionality including utilizing one or more interfaces **192** configured to for example, receive and respond to queries from users at computing devices **110**; interface with inventory companies **140**, manufacturers **150**, sales data companies **160**, financial institutions **170**, DMVs **18**, external sources **184** or dealers **130** to obtain data; or provide data obtained, or determined, by vehicle data system **120** to any of inventory companies **140**, manufacturers **150**, sales data companies **160**, financial institutions **182**, DMVs **180**, external data sources **184** or dealers **130**. It will be understood that the particular interface **192** utilized in a given context may depend on the functionality being implemented by vehicle data system **120**, the type of network **170** utilized to communicate with any particular entity, the type of data to be obtained or presented, the time interval at which data is obtained from the entities, the types of systems utilized at the various entities, etc. Thus, these interfaces may include, for example web pages, web services, a data entry or database application to which data can be entered or otherwise accessed by an operator, or almost any other type of interface which it is desired to utilize in a particular context.

In general, then, using these interfaces **192**, vehicle data system **120** may obtain data from a variety of sources, including one or more of inventory companies **140**, manufacturers **150**, sales data companies **160**, financial institutions **182**, DMVs **180**, external data sources **184** or dealers **130** and store such data in data store **122**. This data may be then grouped, analyzed or otherwise processed by vehicle data system **120** to determine desired data **126** or models **128** which are also stored in data store **122**. A user at computing device **110** may access the vehicle data system **120** through the provided interfaces **192** and specify certain parameters, such as a desired vehicle configuration. The vehicle data system **120** can select a particular set of data in the data store **122** based on the user specified parameters, process the set of data using processing module **196** and models **128**,

generate interfaces using interface module **192** using the selected data set and data determined from the processing, and present these interfaces to the user at the user's computing device **110**. More specifically, in one embodiment interfaces **192** may visually present the selected data set to the user in a highly intuitive and useful manner.

In particular, in one embodiment, a visual interface may present at least a portion of the selected data set as a price curve, bar chart, histogram, etc. that reflects quantifiable prices or price ranges (e.g., "lower prices," "sale price," "market average price," "higher prices" etc.) relative to reference pricing data points or ranges (e.g., trade in price, list price, market low sale price, market average sale price, market high sale price, etc.). Using these types of visual presentations may enable a user to better understand the pricing data related to a specific vehicle configuration.

Turning to the various other entities in topology **100**, dealer **130** may be a retail outlet for vehicles manufactured by one or more of OEMs **150** or may be used vehicle dealers. To track or otherwise manage sales, finance, parts, service, inventory and back office administration needs dealers **130** may employ a dealer management system (DMS) **132**. Since many DMS **132** are Active Server Pages (ASP) based, transaction data **134** may be obtained directly from the DMS **132** with a "key" (for example, an ID and Password with set permissions within the DMS system **132**) that enables data to be retrieved from the DMS system **132**. Many dealers **130** may also have one or more web sites which may be accessed over network **170**, where pricing data pertinent to the dealer **130** may be presented on those web sites, including any pre-determined, or upfront, pricing. This price is typically the "no haggle" (price with no negotiation) price and may be deemed a "fair" price by vehicle data system **120**.

Inventory companies **140** may be one or more inventory polling companies, inventory management companies or listing aggregators which may obtain and store inventory data from one or more of dealers **130** (for example, obtaining such data from DMS **132**). Inventory polling companies are typically commissioned by the dealer to pull data from a DMS **132** and format the data for use on websites and by other systems. Inventory management companies manually upload inventory information (photos, description, specifications) on behalf of the dealer. Listing aggregators get their data by "scraping" or "spidering" websites that display inventory content and receiving direct feeds from listing websites (for example, Autotrader, FordVehicles.com).

DMVs **180** may collectively include any type of government entity to which a user provides data related to a vehicle. For example, when a user purchases a vehicle it must be registered with the state (for example, DMV, Secretary of State, etc.) for tax and titling purposes. This data typically includes vehicle attributes (for example, model year, make, model, mileage, etc.) and sales transaction prices for tax purposes. Additionally, DMVs may maintain tax records of used vehicle transactions, inspection, mileages, etc.).

Financial institution **182** may be any entity such as a bank, savings and loan, credit union, etc. that provides any type of financial services to a participant involved in the purchase of a vehicle. For example, when a buyer purchases a vehicle they may utilize a loan from a financial institution, where the loan process usually requires two steps: applying for the loan and contracting the loan. These two steps may utilize vehicle and consumer information in order for the financial institution to properly assess and understand the risk profile of the loan. Typically, both the loan application and loan agreement include proposed and actual sales prices of the vehicle.

Sales data companies **160** may include any entities that collect any type of vehicle sales data. For example, syndicated sales data companies aggregate new and used sales transaction data from the DMS **132** systems of particular dealers **130**. These companies may have formal agreements with dealers **130** that enable them to retrieve data from the dealer **130** in order to syndicate the collected data for the purposes of internal analysis or external purchase of the data by other data companies, dealers, and OEMs.

Manufacturers **150** are those entities which actually build the vehicles sold by dealers **130**. In order to guide the pricing of their vehicles, the manufacturers **150** may provide an Invoice price and a Manufacturer's Suggested Retail Price (MSRP) for both vehicles and options for those vehicles—to be used as general guidelines for the dealer's cost and price. These fixed prices are set by the manufacturer and may vary slightly by geographic region.

External information sources **184** may comprise any number of other various source, online or otherwise, which may provide other types of desired data, for example data regarding vehicles, pricing, demographics, economic conditions, markets, locale(s), consumers, etc.

Thus, as can be seen, from the above data sources, vehicle data system **120** can obtain and store at least the following data sets (which may be stored, for example, as obtained data **124**): (a) Used vehicle sale transactions: this dataset comprises the individual historical sales transactions, which includes the core information about the sale including the vehicle year, make, model, trim, identification, region, sale price, mileage, condition, options, etc.; (b) Used vehicle listing data: this dataset captures the historical as well as current listings available in the market, which includes vehicle year, make, model, trim, identification, region, listing price, mileage, condition, etc.; (c) Geography data: this dataset comprises mappings across zip code, city, state, region, DMA, etc.; (d) Demographic data: this dataset has demography information such as median household income, median house value at a geographic (e.g., zip code, city, state, region, DMA, etc.) level; (e) Vehicle data: this dataset comprises the vehicle information, such as vehicle year, make, model, trim, engine, transmission, drivetrain, body type, option, MSRP, invoice, etc.; (f) Vehicle residual value data: this data is published by an external data source (e.g., vehicle leasing or finance companies) and comprise estimates of the residual value of used vehicles; and (g) Title history data: this data is specific to individual vehicles such as number of owners, clean title or not, etc.

It should be noted here that not all of the various entities depicted in topology **100** are necessary, or even desired, in embodiments of the invention, and that certain of the functionality described with respect to the entities depicted in topology **100** may be combined into a single entity or eliminated altogether. Additionally, in some embodiments other data sources not shown in topology **100** may be utilized. Topology **100** is therefore exemplary only and should in no way be taken as imposing any limitations on embodiments of the invention.

Using the available data sets then, embodiments may accurately estimate sale price and listing price for a given used vehicle. Sale price is the amount the user paid to purchase the car or it is anticipated a user will pay to purchase a car; listing price refers to the price that the car was/is listed/advertised for on the market. Given both estimations, any owner who wants to sell his/her vehicle can do so with an accurate understanding of the market value of the car.

As discussed above, used car pricing is a more challenging problem compared to new car pricing for a variety of reasons, including considerations of condition, mileage, age, variety, sales velocity, configuration, etc. Embodiments as disclosed herein may account for substantially all these factors and allows us an accurate estimation of sale and listing prices for a given used car.

In particular, turning now to FIG. **2**, a high-level flow diagram **200** illustrating a method for modeling and determining used vehicle pricing data is shown. Initially, this regression model approach includes determining a set of depreciation functions associated with vehicle trims in order to facilitate estimation of a base value of the car (step **202**). Additional key factors can then be incorporated into the regression models to estimate their individual impact or interactions (step **204**). As will be explained in greater detail below, these factors may include (a) Mileage; (b) Condition; (c) Geographic information (region, state, ZIP code, metro, DMA, etc.); (d) Demographic information (household income, house value, etc.); (e) Vehicle attributes (transmission, engine, drivetrain, hybrid, electric, etc.); (f) Vehicle options; and (g) Days to sell.

The days to sell factor captures the market feature that for a given used car the expected price (e.g., sale price) varies depending on the time frame in which the owner wants to sell their vehicle. The days to sell factor may equal the number of days between the date when the vehicle is first listed on the market and the date when the vehicle is sold. Note that even for the exact same vehicle; it can be sold for different prices depending on the time frame in which the owner wants to sell their vehicle.

In addition to the above factors that are considered in the regression model(s), clustering approaches (step **206**) may also applied to overcome sparse data caused, for example, by the drop in sales velocity or the static configuration of a used vehicle. The purpose of clustering is to identify similar vehicles and similar geographic regions so that data points can be pooled together for regression analysis.

Market-level prices can then be estimated to provide owners more insights (step **208**). In one embodiment, the estimation can provide market low, average, and high prices. These prices are estimated based upon the relevant historical sales, a sale price regression analysis, and further adjustments to align with the specific configuration of owners' vehicles (e.g., provided by a user).

Turning now, to FIG. **3**, one embodiment of a method for the aggregation, analysis, and presentation of transaction and pricing data related to vehicles, including used vehicles, is presented in greater detail.

The process **302** may be divided into backend processing **302** and frontend processing **304**. The backend processing **302** may entail the development of one or more models based upon historical transaction data. In certain embodiments, models may be constructed on one or more different levels. For example, a model may be built on a national level, a make level, a model level, a bin level, etc. Furthermore, there may be a set of models for each price which it is desired to determine. For example, there may be a set of models for list price, a set of model for sale price and a set of models for trade in price. Thus, for example, there may be a set of models for list price, each model corresponding to a bin; a set of models for sale price, each model corresponding to a bin and a set of models for trade-in price, each model corresponding to a bin.

The frontend processing **304** may utilize the model(s) developed in the backend processing to determine pricing data to present to the user. More specifically, during the frontend processing **304**, a model associated with an anticipated price (e.g., sale price, list price, trade-in price) and the user-provided vehicle configuration may be determined. Values of the user-specified vehicle configuration (e.g., mileage, condition, etc.) may be used to calculate variables for the model and an anticipated price (e.g., sale price, list price, trade-in price) determined.

Referring first to the embodiment of the backend processing **302** depicted in FIG. **3**, these steps may be utilized in conjunction with the historical transaction data to create a set of models. It will be noted that all, or a subset, of these steps may be repeated for each model it is desired to determine.

In Stage **1** (**306**), a Baseline Valuation is determined. In order to accurately estimate the sale price or listing price for a given used vehicle (or bin), a first step may be to develop a reliable Depreciation Function for vehicle base value. This may be accomplished using the historical transaction data associated with the vehicle or bin.

As noted above, the bin is the group of vehicles in the historical transactions that are of the same make, model, body type, same year (or generation), similar time frame, or similar geography. Exemplary bins are shown in FIG. **4**. In the example illustrated, the bin is defined in terms of Year, Make, Model, and ZIP Code. In some embodiments, ZIP Code refers to a center of a geographic region (e.g., on the order of tens or hundreds of miles). The actual region could be larger than a single ZIP code. In the example illustrated, Bin **1** thus comprises Year 2009, Make Honda, Model Civic, and ZIP Code 90401. Bin **2** comprises Year 2005, Make Toyota, Model Camry, and ZIP Code 78701.

A Depreciation Value may be defined as the decline in value of a vehicle that is no longer considered "New." A Depreciation Function may be defined as a mathematical/statistical formula that will output a current value of the vehicle, given age, mileage, condition, and geography relative to the vehicle's value when "New." Plugging in different age, mileage, condition, and geography parameters will result in an exponential decay function that models the Depreciation Value of a given vehicle.

In order to produce a Depreciation Value for a vehicle, the following data may be accounted for (i) Vehicle Configuration: Year, Make, Model, Trim, Standard Features, manufacturer installed options, and dealer installed options; (ii) Depreciated Valuation Source: such as Lease Residual Values or Dealer Residual Values (Lease Residual Values and Dealer Residual Values are the value of the vehicle after expiration of a lease or on trade-in, respectively); (iii) MSRP and Invoice price; and (iv) Historical transaction data that covers used car sales across all of the United States.

The Baseline Valuation calculation leverages a depreciated valuation source, such as lease residual values, as a response variable on which to construct a Depreciation Function that may be used for a specific vehicle.

The first step in coming up with a Depreciation Function that is tailored for a specific vehicle may be to build a generalized Exponential Decay curve that models the Depreciation Value of the vehicle given different age inputs. This is done by fitting an exponential decay curve to a depreciated valuation, and the result is a function in the form of:

$$Y=\beta e^{-\delta t} \quad \text{(Eq. 1)}$$

where β and δ are estimates from a non-linear fit regression model that has the functional form of the equation above, where the dependent variable, Y, is the natural log of the vehicle's residual value as defined by sources that set

residual values. It is defined as vehicle age, computed as Today's Year less the Model Year of the vehicle.

In one embodiment, the following principles may also apply to the dependent variable Y:

The structure can be decomposed additively into a mean function and an error component.

The model errors are uncorrelated and have zero mean.

The mean function consists of known regressor variables and unknown constants (β and δ)

Thus, from this exercise, we have a prediction of the form:

$$\hat{Y}=\beta e^{-\delta t} \quad \text{(Eq. 2)}$$

Where $\hat{Y}$ is the natural log of a predicted residual value, which can be transformed into a predicted current baseline valuation. In particular, the Baseline Valuation would be the product of the MSRP with the anti-log of Y.

Stage **2** (**308**): Residual Valuation

Next, in Stage **2** (**308**), the transaction residual values of vehicles may be modeled as a function of (1) the Exponential Decay estimate, (2) mileage, (3) condition, and (4) geography. A Linear Regression may be used to generate estimates for the possible parameters. The dependent variable is the vehicle's baseline valuation divided by the Vehicle's MSRP Value as new. The resulting formula for Residual Value is a linear function that is of the form:

$$Y=\beta_0+\Sigma\beta_i X_i+\varepsilon \quad \text{(Eq. 3)}$$

where Y is the baseline valuation/MSRP at transactional level, the betas are the parameters that have been estimated, and the Xi's are the values for the predicted residual value (from Stage **1** (**306**) above), mileage, condition (which can be input as indicator variables or ordinal values), and geography (which can be input as indicator variables). This formula can then be used to obtain an accurate Residual Value of any vehicle, with any mileage, condition, and geographical location. This is done by applying the Depreciation Function to the vehicle value as "New." The result is stored (**316**) and, as will be explained in greater detail below, may be used by the Frontend **304** to derive the final price.

Stage **3** (**310**). Clustering of Vehicles and Geographic Regions

In some embodiments, it may be the case that the historical models might not have enough coverage across all the geographic regions. It may be important then to estimate the prices for these sparse models based on the most similar models. This may be achieved by clustering the most similar vehicle models based on the vehicle and geography. Here the similarities of models can be defined with make, body type, vehicle type (truck, SUV, coupe, convertible, etc.), engine, transmission, etc. Also, given the depreciation functions developed (as described above), the clustering process may be supervised by the normalized prices (as divided by residual value) instead of the actual prices. A final bin for a specific vehicle will be referred to herein as q. In addition, as will be discussed in greater detail below, the residual values **316** may be used by the frontend **304** to derive the final price.

Stage **4** (**312**). Construction of Research Dataset

After classifying transactions data into clusters of vehicles having similar characteristics, research datasets **318** may be constructed for the vehicle pricing. In some embodiments, the research datasets are constructed using the following operations:

Use of temporally-weighted historical data to generate a sufficient number of observations needed to draw inferences with acceptable confidence;

Use of geo-specific socioeconomic variables to account for geographic differences in consumer behavior (e.g., median income, median home prices); and Vehicle-specific attributes (e.g., engine type, drive type).

4.1 Temporal Weighting of Historical Observations

Every historical transaction, y_i, can be used in the modeling process. However, use of a transaction that occurred in the very distant past may cause misleading results, particularly if the used-car market has witnessed recent changes such as the price jump due to supply interruptions caused by natural disasters or seasonal fluctuations. To put emphasis on more recent transactions and thereby more quickly capture change, a temporal weight is assigned to each observation based on its age in weeks. The approach used is an exponentially weighted moving average:

$$S_t=\alpha Y_{t-1}+(1-\alpha)S_{t-1} \quad \text{(Eq. 4)}$$

Above, S_t represents the exponentially weighted moving average in week t, α is a parameter controlling how quickly historical transactions are discounted and Y_{t-1} is price of transactions occurring in week t−1.

It may be important to choose the appropriate value of a. An analysis of historical performance can be used to aid in the selection of the appropriate value. In the event where there are many transactions observed, say, in the last four (4) weeks, an unweighted average of these transactions can be used as it may provide a timely and robust measure or prices without relying upon historical data.

4.2 Geo-Specific Socioeconomic Data

Because consumer demand may vary with geography based on the characteristics and taste of the local population, a set of variables z may be used. These variables may include, for example, geo-specific information obtained from data providers and the US Census Bureau (based on the most recent decennial census): 1) fraction of rural households in the locality compared to national percentage, 2) median home price in the locality compared to the national median home price, 3) percentage of work force participation in locality compared to national work force participation and, using another data source with the locations of all US car dealers 4) the number of vehicle dealerships for a specific make in the locality.

4.3 Vehicle-Specific Attributes

To account for structural and pricing differences in each vehicle, a set of variables x may be considered. These variables may include: 1) the natural logarithm of the MSRP of the base vehicle without options, 2) natural logarithm of the ratio of MSRP of the vehicle with options and the base vehicle, 3) the vehicle body type (SUV, Van, Truck, Sedan, Coupe, Convertible), 4) fuel type (electric, diesel, hybrid, gasoline), 5) transmission type (automatic, manual), 6) drive type (4-wheel drive, front-wheel drive, rear-wheel drive) and 7) the number of cylinders in the vehicle's engine.

4.4 Usage/Maintenance of Vehicle

To account for the usage and maintenance of each vehicle, a set of variables y may be considered. These variables may include: 1) mileage on the vehicle, 2) condition of the vehicle; 3) title history. Title history is specific to individual vehicles. It indicates whether the vehicle has been properly maintained. This also helps estimate the actual condition of the vehicle.

4.5 Days-to-Sell

The number of days to sell a vehicle is an important factor on the listing price and the price at which the car is sold eventually. To observe the historical days to sell, the listings and transactions data may be merged to get the day a listing was added and the actual date the vehicle was sold. Then the

number of days to sell can be derived. Note that even for the exact same vehicle, it can be sold for different prices depending how soon the owner wants to sell. If the owner trades in the vehicle which is likely to be lower price, then it is only matter of days. In addition, listing price will affect the number of interested buyers thus the days to sell as well.

Stage **5** (**314**). Offline Regression Model

Here, a model is built for the normalized price ratio (pr) defined as pr=

$$\frac{\text{price}}{\text{depreciated value}} \text{ relative to its weighted mean value of similar vehicles and regions.}$$

This work can be summarized by the equation:

$$pr_i-\overline{pr_q}=\alpha_o+\alpha_m+\Sigma_j\beta_j\cdot x_i+\Sigma_k\delta_k\cdot y_k+\Sigma_l\lambda_l\cdot z_l+\Sigma_n\theta_n\cdot v_n+\varepsilon_i \quad \text{(Eq. 5)}$$

Which can be rewritten in the more familiar form as:

$$pr_i-\overline{pr_q}=\alpha_o+\alpha_m+\Sigma_j\beta_j\cdot x_i+\Sigma_k\delta_k\cdot y_k+\Sigma_l\lambda_l\cdot z_l+\Sigma_n\theta_n\cdot v_n+\varepsilon_i \quad \text{(Eq. 6)}$$

Where

$$\overline{pr_q}=\left(\frac{\sum_{i\in q} w_i mr_i}{\sum_{i\in q} w_i}\right) \quad \text{(Eq. 7)}$$

In the preceding equation, the features in set x represent the set of regression variables which impact the price ratio such as vehicle attributes, the set y represents the usage/maintenance data, and the set z represents local-level customer and demographic information as well as industry-level data, the set v represents the days-to-sell data, α_o is a global intercept term, α_m is a make-level intercept applied only when $i\in m$, and $\overline{pr_q}$ denotes a weighted average of the price ratios for the particular bin q. ε_i is the error term.

The model can be fitted using weighted Ordinary Least Squares (OLS) to find the regression coefficients (i.e., the estimated parameters $\hat{\alpha}$, $\hat{\beta}$, $\hat{\delta}$, $\hat{\lambda}$, $\hat{\theta}$ that result in the smallest sum of temporally weighted squared residuals). The results are then stored (**320**) for use in deriving the final price in the frontend, as will be discussed in greater detail below.

Given the results of the regression equation, the predicted price ratio of a vehicle i in a bin q is then $\widehat{pr_i}=\widehat{pr_i}+\overline{pr_q}$, where $\widehat{pr_i}$ is the predicated price ratio that results from the model. The pr hat can be thought of as an estimate of how a vehicle differs from the average (pr bar).

The final estimated price for vehicle in transaction i is then

$$\widehat{price_i}=\widehat{pr_i}\times\text{depreciated value}_i. \quad \text{(Eq. 8)}$$

Note that in some embodiments, the regression step is gone through multiple times where price is changed to meet desired needs. Specifically, for a projection on recommended list price, list price data can be used as the dependent variable to predict list prices. If sale price is the goal, the process can be accomplished in the same fashion with list price as the dependent variable, which then provides us with a projection for recommended sale price.

All of the above describes the construction of the linear regression models in the backend (**302**). Thus, using the data determined in the backend processes, the user may obtain pricing data for a specified vehicle as depicted in the frontend processing (**304**) of FIG. **3**.

In a Step **1** (**330**), a User selects the vehicle year, make, model, and trim. The user also may provide the zip code to estimate the price in. An embodiment of an interface which may be presented to a user to allow him to provide such data is depicted in FIG. **6**.

In Step **2** (**332**), the User may select the vehicle condition, engine, transmission, drivetrain, and options subject to the selected vehicle trim; the use may also enter the mileage on the vehicle. An embodiment of an interface which may be presented to a user to allow him to provide such data is depicted in FIG. **7**.

After the user selects the vehicle and mileage and condition, then pricing data to display to the user is algorithmically determined using models (as discussed above), including for example, list, sale, or trade-in pricing.

Thus, through steps **1** and **2**, the user has described a specific vehicle. Based on the data provided by the user, values for the variables in the pricing equation may be filled in. Note that the parameters have been defined by the initial process of leveraging the obtained data to fit the models and set those coefficients in the backend processing, as described above.

Thus, a series of calculations happen right after step **2** (**332**) in order to present pricing data. The calculations may be done using a model determined in the backend processing as described above.

- A bin q may be determined based on user input from steps **1** and **2**.
- All historical transactions may be pulled together from the same bin q as the user-selected vehicle in order to calculate the average price ratio (**334**). An example of the pricing data for a particular vehicle is shown in the table of FIG. **5**. For example, if the user input information for a 2009 Honda Civic LX in the 90401 zip code, as well as additional information described above, the result would be to pull the listing of vehicles by Year, Make, Model, Trim, zip code, and price (pr). In the example illustrated, the bin is defined at the "Model" level rather than the trim level. Thus, historical data under other trims within the same model may be used. The pricing data for individual cars (pr) may be used to determine an average price.
- Vehicle attributes may be collected for the user-selected vehicle and corresponding set of regression variables x are derived (**336**).
- Based upon the user-entered mileage and condition, all relevant set of regression variables y may be calculated (**336**).
- Local-level customer and demographic information may be collected based upon user-entered zip code and all relevant set of regression variables z may be derived (**336**).
- Average days-to-sell may be calculated from historical transactions as a default value on the price report and the set of regression variables v can be calculated for the model (**334**).
- The regression coefficients $\hat{\alpha}$, $\hat{\beta}$, $\hat{\delta}$, $\hat{\lambda}$, $\hat{\theta}$ which may have been pre-calculated (**320**), may be plugged into the regression variable sets x, y, z, v (as well as the average price ratio), and an expected price ratio may be obtained: $\widehat{pr_i}=\widehat{pr_i}+\overline{pr_q}$. A residual or depreciated value using the user-input data may be calculated based upon the decay curve and depreciation function that has been developed.
- Given the depreciated value calculated above, the expected price (**338**) can be obtained: $\widehat{price}_1=\widehat{pr_i}\times$depreciated value$_i$

In Step **3** (**340**), the determined pricing data can then be presented to a user. A user thus accesses a price report where pricing data including expected sale price and list price are presented. An embodiment of an interface which may be presented to a user with such pricing data is depicted in FIG. **8**.

In Step **4** (**342**), on the presented interface (FIGS. **6-8**), the user may have the ability to enter additional frontend information to modify calculations further. Specifically, in some embodiments, the user can enter changes to the vehicle condition, mileage, and the anticipated days to sell. With changes to these selected elements, specific frontend algorithmic adjustments may be made and presented to the user through the interface.

An example embodiment of a pricing system is shown in greater detail in the flowchart **900** of FIG. **9**. More particularly, shown are operations implemented at frontend **902** and backend **904**.

The backend process **902** may receive as inputs configuration data (e.g., vehicle trim data) (**906**), as well as manufacturer pricing (**910**), depreciation data (**912**) and transaction data (mileage and age adjustments) (**914**). This data may be available from a variety of outside vendors or public sources and may be available as commercial or public databases. In some embodiments, the vehicle trim data may comprise vehicle trim data for vehicles over a predetermined period, such as for the past twenty years.

These inputs may be used to compute the retail value based on the exponential decay depreciation and regression factors discussed above (**908**), corresponding to Stage **2** and Stage **3** of FIG. **3**. In some embodiments, the resulting residual decay estimates may be applied to the used car transaction(s) (corresponding to Stage **4** of FIG. **3**), although in other implementations, actual retail value data may be used (**916**). This process focuses on the frontend logic, whereas the regression coefficients are already derived from backend.

In either case, the residual values, as well as the manufacturer configuration data (**906**), are added to the used car transaction database (**920**), i.e., the research dataset (**318**, FIG. **3**). In addition, options data may be provided (step **918**) to the used car transaction database. Options data corresponds to the value of the options on the vehicle when new and the current residual value.

The backend processing **902**, and updating of the regression coefficients, may occur on a regular basis, such as a daily or weekly basis.

As noted above, the frontend processing **904** is run in response to user input data about his or her automobile and other information, such as zip to zip distance and radius data (**922**), and socio-economic data, such as income, population, home prices by zip code, etc. (**926**). User input can include, for example, vehicle characteristics, mileage, condition, age, geography, and time on market. Regression variables may then be constructed based on these inputs (**924**). As noted above, such inputs can be received via a user interface, such as those of FIGS. **6-8**.

At step **928**, the system may determine if there are sufficient transactions for a given YMM (year, make, model) within a particular distance of the zip code For example, in some embodiments, a base of 100 miles of each zip code are used.

If so, then an average price may be determined as described above (**930**). The final price maybe derived based on the regression variables, the regression coefficients, and the research dataset (**932**). In some embodiments, the individual transaction price ratio may be normalized against a corresponding local price ratio of vehicles within the predetermined radius. In other embodiments, a national price ratio may be used.

Embodiments disclosed herein may be implemented in or in conjunction with embodiments disclosed in commonly-assigned, U.S. patent application Ser. No. 12/556,076, filed Sep. 9, 2009, issued as U.S. Pat. No. 9,129,325, and entitled "SYSTEM AND METHOD FOR AGGREGATION, ANALYSIS, PRESENTATION AND MONETIZATION OF PRICING DATA FOR VEHICLES AND OTHER COMMODITIES," which is hereby incorporated by reference in its entirety. It should be noted that the embodiments depicted therein may be used in association with specific embodiments and any language used to describe such embodiments, including any language that may be in any way construed as restrictive or limiting (e.g., must, needed, required, etc.) should only be construed as applying to that, or those, particular embodiments.

Although the invention has been described with respect to specific embodiments thereof, these embodiments are merely illustrative, and not restrictive of the invention. The description herein of illustrated embodiments of the invention, including the description in the Abstract and Summary, is not intended to be exhaustive or to limit the invention to the precise forms disclosed herein (and in particular, the inclusion of any particular embodiment, feature or function within the Abstract or Summary is not intended to limit the scope of the invention to such embodiment, feature or function). Rather, the description is intended to describe illustrative embodiments, features and functions in order to provide a person of ordinary skill in the art context to understand the invention without limiting the invention to any particularly described embodiment, feature or function, including any such embodiment feature or function described in the Abstract or Summary. While specific embodiments of, and examples for, the invention are described herein for illustrative purposes only, various equivalent modifications are possible within the spirit and scope of the invention, as those skilled in the relevant art will recognize and appreciate. As indicated, these modifications may be made to the invention in light of the foregoing description of illustrated embodiments of the invention and are to be included within the spirit and scope of the invention. Thus, while the invention has been described herein with reference to particular embodiments thereof, a latitude of modification, various changes and substitutions are intended in the foregoing disclosures, and it will be appreciated that in some instances some features of embodiments of the invention will be employed without a corresponding use of other features without departing from the scope and spirit of the invention as set forth. Therefore, many modifications may be made to adapt a particular situation or material to the essential scope and spirit of the invention.

Reference throughout this specification to "one embodiment", "an embodiment", or "a specific embodiment" or similar terminology means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment and may not necessarily be present in all embodiments. Thus, respective appearances of the phrases "in one embodiment", "in an embodiment", or "in a specific embodiment" or similar terminology in various places throughout this specification are not necessarily referring to the same embodiment. Furthermore, the particular features, structures, or characteristics of any particular embodiment may be combined in any suitable manner with one or more other embodiments. It is to be understood that other variations and modifications of

the embodiments described and illustrated herein are possible in light of the teachings herein and are to be considered as part of the spirit and scope of the invention.

In the description herein, numerous specific details are provided, such as examples of components and/or methods, to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that an embodiment may be able to be practiced without one or more of the specific details, or with other apparatus, systems, assemblies, methods, components, materials, parts, and/or the like. In other instances, well-known structures, components, systems, materials, or operations are not specifically shown or described in detail to avoid obscuring aspects of embodiments of the invention. While the invention may be illustrated by using a particular embodiment, this is not and does not limit the invention to any particular embodiment and a person of ordinary skill in the art will recognize that additional embodiments are readily understandable and are a part of this invention.

Embodiments discussed herein can be implemented in a computer communicatively coupled to a network (for example, the Internet), another computer, or in a standalone computer. As is known to those skilled in the art, a suitable computer can include a central processing unit ("CPU"), at least one read-only memory ("ROM"), at least one random access memory ("RAM"), at least one hard drive ("HD"), and one or more input/output ("I/O") device(s). The I/O devices can include a keyboard, monitor, printer, electronic pointing device (for example, mouse, trackball, stylus, touch pad, etc.), or the like.

ROM, RAM, and HD are computer memories for storing computer-executable instructions executable by the CPU or capable of being compiled or interpreted to be executable by the CPU. Suitable computer-executable instructions may reside on a computer-readable medium (e.g., ROM, RAM, and/or HD), hardware circuitry or the like, or any combination thereof. Within this disclosure, the term "computer-readable medium" or is not limited to ROM, RAM, and HD and can include any type of data storage medium that can be read by a processor. For example, a computer-readable medium may refer to a data cartridge, a data backup magnetic tape, a floppy diskette, a flash memory drive, an optical data storage drive, a CD-ROM, ROM, RAM, HD, or the like. The processes described herein may be implemented in suitable computer-executable instructions that may reside on a computer-readable medium (for example, a disk, CD-ROM, a memory, etc.). Alternatively, the computer-executable instructions may be stored as software code components on a direct access storage device array, magnetic tape, floppy diskette, optical storage device, or other appropriate computer-readable medium or storage device.

Any suitable programming language can be used to implement the routines, methods or programs of embodiments of the invention described herein, including C, C++, Java, JavaScript, HTML, or any other programming or scripting code, etc. Other software/hardware/network architectures may be used. For example, the functions of the disclosed embodiments may be implemented on one computer or shared/distributed among two or more computers in or across a network. Communications between computers implementing embodiments can be accomplished using any electronic, optical, radio frequency signals, or other suitable methods and tools of communication in compliance with known network protocols.

Different programming techniques can be employed such as procedural or object oriented. Any particular routine can execute on a single computer processing device or multiple computer processing devices, a single computer processor or multiple computer processors. Data may be stored in a single storage medium or distributed through multiple storage mediums, and may reside in a single database or multiple databases (or other data storage techniques). Although the steps, operations, or computations may be presented in a specific order, this order may be changed in different embodiments. In some embodiments, to the extent multiple steps are shown as sequential in this specification, some combination of such steps in alternative embodiments may be performed at the same time. The sequence of operations described herein can be interrupted, suspended, or otherwise controlled by another process, such as an operating system, kernel, etc. The routines can operate in an operating system environment or as stand-alone routines. Functions, routines, methods, steps and operations described herein can be performed in hardware, software, firmware or any combination thereof.

Embodiments described herein can be implemented in the form of control logic in software or hardware or a combination of both. The control logic may be stored in an information storage medium, such as a computer-readable medium, as a plurality of instructions adapted to direct an information processing device to perform a set of steps disclosed in the various embodiments. Based on the disclosure and teachings provided herein, a person of ordinary skill in the art will appreciate other ways and/or methods to implement the invention.

It is also within the spirit and scope of the invention to implement in software programming or code an of the steps, operations, methods, routines or portions thereof described herein, where such software programming or code can be stored in a computer-readable medium and can be operated on by a processor to permit a computer to perform any of the steps, operations, methods, routines or portions thereof described herein. The invention may be implemented by using software programming or code in one or more digital computers, by using application specific integrated circuits, programmable logic devices, field programmable gate arrays, optical, chemical, biological, quantum or nanoengineered systems, components and mechanisms may be used. In general, the functions of the invention can be achieved by any means as is known in the art. For example, distributed, or networked systems, components and circuits can be used. In another example, communication or transfer (or otherwise moving from one place to another) of data may be wired, wireless, or by any other means.

A "computer-readable medium" may be any medium that can contain, store, communicate, propagate, or transport the program for use by or in connection with the instruction execution system, apparatus, system or device. The computer-readable medium can be, by way of example only but not by limitation, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, system, device, propagation medium, or computer memory. Such computer-readable medium shall generally be machine readable and include software programming or code that can be human readable (e.g., source code) or machine readable (e.g., object code). Examples of non-transitory computer-readable media can include random access memories, read-only memories, hard drives, data cartridges, magnetic tapes, floppy diskettes, flash memory drives, optical data storage devices, compact-disc read-only memories, and other appropriate computer memories and data storage devices. In an illustrative embodiment, some or all of the software components may reside on a single server computer or on any combination of separate server computers. As one skilled in

the art can appreciate, a computer program product implementing an embodiment disclosed herein may comprise one or more non-transitory computer-readable media storing computer instructions translatable by one or more processors in a computing environment.

A "processor" includes any, hardware system, mechanism or component that processes data, signals or other information. A processor can include a system with a central processing unit, multiple processing units, dedicated circuitry for achieving functionality, or other systems. Processing need not be limited to a geographic location, or have temporal limitations. For example, a processor can perform its functions in "real-time," "offline," in a "batch mode," etc. Portions of processing can be performed at different times and at different locations, by different (or the same) processing systems.

It will also be appreciated that one or more of the elements depicted in the drawings/figures can also be implemented in a more separated or integrated manner, or even removed or rendered as inoperable in certain cases, as is useful in accordance with a particular application. Additionally, any signal arrows in the drawings/Figures should be considered only as exemplary, and not limiting, unless otherwise specifically noted.

As used herein, the terms "comprises," "comprising," "includes," "including," "has," "having," or any other variation thereof, are intended to cover a non-exclusive inclusion. For example, a process, product, article, or apparatus that comprises a list of elements is not necessarily limited only those elements but may include other elements not expressly listed or inherent to such process, product, article, or apparatus.

Furthermore, the term "or" as used herein is generally intended to mean "and/or" unless otherwise indicated. For example, a condition A or B is satisfied by any one of the following: A is true (or present) and B is false (or not present), A is false (or not present) and B is true (or present), and both A and B are true (or present). As used herein, including the claims that follow, a term preceded by "a" or "an" (and "the" when antecedent basis is "a" or "an") includes both singular and plural of such term, unless clearly indicated within the claim otherwise (i.e., that the reference "a" or "an" clearly indicates only the singular or only the plural). Also, as used in the description herein and throughout the claims that follow, the meaning of "in" includes "in" and "on" unless the context clearly dictates otherwise. The scope of the present disclosure should be determined by the following claims and their legal equivalents.

What is claimed is:

1. A computer-implemented method of used vehicle data processing, the method comprising:

receiving, from disparate data sources over a network by a backend process as inputs, vehicle trim data on vehicles over a past time period, vehicle manufacturer data on the vehicles when new, depreciation data on the vehicles or similar vehicle models, and vehicle price records on the vehicles, the backend process operated by a vehicle data system having a processor and a non-transitory computer-readable medium, the vehicle data system having a server computer that provides a web site or web service on Internet;

computing, by the backend process, current retail values of the vehicles using a linear function, the computing comprising generating estimates for parameters of the linear function;

applying, by the backend process, the current retail values of the vehicles to the vehicle price records;

appending, by the backend process, a used vehicle research dataset with the current retail values of the vehicles as applied to the vehicle price records;

updating, by the backend process, the estimates for the parameters of the linear function at a time interval;

receiving, by the server computer through the web site or web service on the Internet, user input data comprising a zip code and vehicle year, make, model, trim, condition, and mileage of a used vehicle;

responsive to the user input data, constructing, by a frontend process based on the user input data, sets of regression variables including a set of regression variables constructed based on vehicle attributes of the used vehicle, a set of regression variables constructed based on the condition and mileage of the used vehicle, and a set of regression variables constructed based on the zip code, the frontend process operated by the vehicle data system;

determining, by the frontend process using the zip code and the vehicle year, make, model, and trim of the used vehicle, a set of vehicles in a bin from the used vehicle research dataset, wherein each vehicle of the set of vehicles in the bin has same vehicle year, make, model, and trim as the used vehicle and wherein each vehicle of the set of vehicles in the bin is in a geographic region inclusive of the zip code of the used vehicle;

determining, by the frontend process, an expected price of the used vehicle in the zip code using an average price for the used vehicle based on the current values of the set of vehicles in the bin from the used vehicle research dataset and a depreciated value of the used vehicle based on the sets of regression variables and the estimates for the parameters updated by the backed process; and

presenting the expected price of the used vehicle in the zip code on a user device over the Internet.

2. The computer-implemented method according to claim **1**, wherein the presenting comprises presenting the expected price of the used vehicle in the zip code within a range of prices.

3. The computer-implemented method according to claim **1**, wherein the expected price of the used vehicle in the zip code is associated with a number of average days to sale such that the expected price of the used vehicle in the zip code and the number of average days to sale are interdependent.

4. The computer-implemented method according to claim **3**, further comprising:

presenting a user interface element on the user device for adjusting the number of average days to sale.

5. The computer-implemented method according to claim **4**, further comprising:

receiving, by the frontend process from the user device, an adjustment to the number of average days to sale through the user interface element; and

in response to the adjustment to the number of average days to sale, adjusting, by the frontend process, the expected price of the used vehicle in the zip code presented on the user device.

6. The computer-implemented method according to claim **1**, wherein the expected price of the used vehicle in the zip code determined by the frontend process comprises a listing price of the used vehicle in the zip code, a sale price of the used vehicle in the zip code, or a trade-in price of the used vehicle in the zip code.

7. The computer-implemented method according to claim **1**, further comprising:

prior to determining the set of vehicles from the used vehicle research dataset, determining, by the backend process, whether sufficient price records for the vehicle year, make, model, and trim of the used vehicle within a distance of the zip code exist in the used vehicle research dataset; and

responsive to insufficient price records for the vehicle year, make, model, and trim of the used vehicle within the distance of the zip code in the used vehicle research dataset, performing, by the backend process, a clustering process to include additional historical price records involving vehicle models in the used vehicle research dataset that are most similar to the used vehicle in the zip code.

8. A vehicle data system for used vehicle data processing, the vehicle data system comprising:

a server computer that provides a web site or web service on Internet, the server computer having a processor and a non-transitory computer-readable medium storing instructions translatable by the processor for:

operating a backend process, comprising:

receiving, from disparate data sources over a network as inputs, vehicle trim data on vehicles over a past time period, vehicle manufacturer data on the vehicles when new, depreciation data on the vehicles or similar vehicle models, and vehicle price records on the vehicles;

computing current retail values of the vehicles using a linear function, the computing comprising generating estimates for parameters of the linear function;

applying the current retail values of the vehicles to the vehicle price records;

appending a used vehicle research dataset with the current retail values of the vehicles as applied to the vehicle price records; and

updating the estimates for the parameters of the linear function at a time interval;

receiving, through the web site or web service on the Internet, user input data comprising a zip code and vehicle year, make, model, trim, condition, and mileage of a used vehicle; and

operating a frontend process comprising:

responsive to the user input data, constructing, based on the user input data, sets of regression variables including a set of regression variables constructed based on vehicle attributes of the used vehicle, a set of regression variables constructed based on the condition and mileage of the used vehicle, and a set of regression variables constructed based on the zip code, the frontend process operated by the vehicle data system;

determining, using the zip code and the vehicle year, make, model, and trim of the used vehicle, a set of vehicles in a bin from the used vehicle research dataset, wherein each vehicle of the set of vehicles in the bin has same vehicle year, make, model, and trim as the used vehicle and wherein each vehicle of the set of vehicles in the bin is in a geographic region inclusive of the zip code of the used vehicle;

determining, by the frontend process, an expected price of the used vehicle in the zip code using an average price for the used vehicle based on the current values of the set of vehicles in the bin from the used vehicle research dataset and a depreciated value of the used vehicle based on the sets of regression variables and the estimates for the parameters updated by the backed process; and

presenting the expected price of the used vehicle in the zip code on a user device over the Internet.

9. The vehicle data system of claim **8**, wherein the presenting comprises presenting the expected price of the used vehicle in the zip code within a range of prices.

10. The vehicle data system of claim **8**, wherein the expected price of the used vehicle in the zip code is associated with a number of average days to sale such that the expected price of the used vehicle in the zip code and the number of average days to sale are interdependent.

11. The vehicle data system of claim **8**, wherein the frontend process further comprises:

presenting a user interface element on the user device for adjusting the number of average days to sale.

12. The vehicle data system of claim **11**, wherein the frontend process further comprises:

receiving, from the user device, an adjustment to the number of average days to sale through the user interface element; and

in response to the adjustment to the number of average days to sale, adjusting the expected price of the used vehicle in the zip code presented on the user device.

13. The vehicle data system of claim **8**, wherein the expected price of the used vehicle in the zip code determined by the frontend process comprises a listing price of the used vehicle in the zip code, a sale price of the used vehicle in the zip code, or a trade-in price of the used vehicle in the zip code.

14. The vehicle data system of claim **8**, wherein the backend process further comprises:

prior to determining the set of vehicles from the used vehicle research dataset, determining whether sufficient price records for the vehicle year, make, model, and trim of the used vehicle within a distance of the zip code exist in the used vehicle research dataset; and

responsive to insufficient price records for the vehicle year, make, model, and trim of the used vehicle within the distance of the zip code in the used vehicle research dataset, performing a clustering process to include additional historical price records involving vehicle models in the used vehicle research dataset that are most similar to the used vehicle in the zip code.

15. A computer program product for used vehicle data processing, the computer program product comprising a non-transitory computer-readable medium storing instructions translatable by a server computer that provides a web site or web service on Internet, the instructions when translated by the server computer perform:

operating a backend process, comprising:

receiving, from disparate data sources over a network as inputs, vehicle trim data on vehicles over a past time period, vehicle manufacturer data on the vehicles when new, depreciation data on the vehicles or similar vehicle models, and vehicle price records on the vehicles;

computing current retail values of the vehicles using a linear function, the computing comprising generating estimates for parameters of the linear function;

applying the current retail values of the vehicles to the vehicle price records;

appending a used vehicle research dataset with the current retail values of the vehicles as applied to the vehicle price records; and

updating the estimates for the parameters of the linear function at a time interval;

receiving, through the web site or web service on the Internet, user input data comprising a zip code and vehicle year, make, model, trim, condition, and mileage of a used vehicle; and

operating a frontend process comprising:

responsive to the user input data, constructing, based on the user input data, sets of regression variables including a set of regression variables constructed based on vehicle attributes of the used vehicle, a set of regression variables constructed based on the condition and mileage of the used vehicle, and a set of regression variables constructed based on the zip code, the frontend process operated by the vehicle data system;

determining, using the zip code and the vehicle year, make, model, and trim of the used vehicle, a set of vehicles in a bin from the used vehicle research dataset, wherein each vehicle of the set of vehicles in the bin has same vehicle year, make, model, and trim as the used vehicle and wherein each vehicle of the set of vehicles in the bin is in a geographic region inclusive of the zip code of the used vehicle;

determining, by the frontend process, an expected price of the used vehicle in the zip code using an average price for the used vehicle based on the current values of the set of vehicles in the bin from the used vehicle research dataset and a depreciated value of the used vehicle based on the sets of regression variables and the estimates for the parameters updated by the backed process; and

presenting the expected price of the used vehicle in the zip code on a user device over the Internet.

16. The computer program product of claim **15**, wherein the presenting comprises presenting the expected price of the used vehicle in the zip code within a range of prices.

17. The computer program product of claim **15**, wherein the expected price of the used vehicle in the zip code is associated with a number of average days to sale such that the expected price of the used vehicle in the zip code and the number of average days to sale are interdependent.

18. The computer program product of claim **15**, wherein the frontend process further comprises:

presenting a user interface element on the user device for adjusting the number of average days to sale.

19. The computer program product of claim **18**, wherein the frontend process further comprises:

receiving, from the user device, an adjustment to the number of average days to sale through the user interface element; and

in response to the adjustment to the number of average days to sale, adjusting the expected price of the used vehicle in the zip code presented on the user device.

20. The computer program product of claim **15**, wherein the backend process further comprises:

prior to determining the set of vehicles from the used vehicle research dataset, determining whether sufficient price records for the vehicle year, make, model, and trim of the used vehicle within a distance of the zip code exist in the used vehicle research dataset; and

responsive to insufficient price records for the vehicle year, make, model, and trim of the used vehicle within the distance of the zip code in the used vehicle research dataset, performing a clustering process to include additional historical price records involving vehicle models in the used vehicle research dataset that are most similar to the used vehicle in the zip code.

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